

combined with a mineral oil carrier fluid (1373 wppm), decreased IVD but increased CCD and altered the chemical composition of the deposit relative to base fuel.

00/01006 A comparative performance analysis of irreversible Carnot heat engines under maximum power density and maximum power conditions

Kodal, A. *et al.* *Energy Convers. & Manage.*, 2000, 41, (3), 235–248.
This paper reports the finite time thermodynamic optimization based on the maximum power density criterion for an irreversible Carnot heat engine model which includes three types of irreversibilities: finite rate heat transfer, heat leakage and internal irreversibility. The obtained results are compared with those results obtained by using the maximum power criterion. The design parameters under the optimal conditions have been derived analytically and the effects of the irreversibilities on the general and optimal performances are investigated. The results showed that the design parameters at maximum power density lead to smaller and more efficient heat engines. It is also seen that the irreversibilities have a greater influence on the performances at maximum power density conditions with respect to the ones at maximum power conditions. Also in this study, the optimal conductance allocation parameter is investigated at both maximum power density and maximum power conditions by assuming a constrained total thermal conductance in the case when there is no heat leakage. The relation between the conductance allocation parameter and the thermal efficiencies at maximum power density and maximum power is also investigated. The obtained results generalize the result of previous studies on this subject and provide guidance to optimal design in terms of power, thermal efficiency and engine sizes for real heat engines.

00/01007 Cost attribution methodologies in cogeneration systems

da Gama, S. A. A. and Azucena Nebra, S. *Energy Convers. & Manage.*, 1999, 40, (15–16), 1587–1597.

The design and operation analysis and optimization of complex thermal plants, in terms of both thermal and economical variables, is the subject of Thermoeconomics. Several different thermoeconomical methodologies are presented in the literature, each one based upon different principles and therefore presenting somewhat different results. In this article, four methodologies developed by diverse authors are applied to a simple gas turbine cogeneration system. The results are compared: the importance of the division of exergy into mechanical and thermal components and the allocation of the cost of external irreversibility are discussed.

00/01008 Development and validation of a coal/biomass fuelled gas turbine combustor model

Hoppesteyn, P. D. J. *et al.* *PVP (Am. Soc. Mech. Eng.)*, 1998, 377, (Computational Technologies for Fluid/Thermal/Structural/Chemical Systems with Industrial Applications, Vol. 2), 177–189.

The consumption of biomass does not add carbon dioxide to the atmosphere and is consequently attracting increasing interest in power plant technology. Biomass absorbs the same amount of carbon dioxide in growing as it releases when consumed as fuel. The co-gasification of coal and biomass, producing a low calorific value (LCV) fuel gas which can be used as a fuel for modern gas turbines seems a technically attractive option in the short term. In this paper, the first experimental results are presented of the combustion of LCV fuel gas, obtained by pressurized fluidized bed gasification of coal-biomass mixtures. The gasification conditions were 0.8 MPa with air or oxygen in a vertical cylindrical chamber ($D = 0.28$ m, $L = 1.2$ m). The fuel ($T = 1060$ K) and oxydizer (air at 350 K, oxygen at 460 K) were injected coaxially, resulting in an essentially axisym flow pattern. Particles were removed from the fuel gas stream by a cyclone, mounted between the gasifier and the combustor. Temperatures, flow patterns and species concentrations throughout the combustor were calculated using a purposely developed two dimensional model, implemented in the CFD code FLUENT. The calculated results are compared with experimental data for two LCV fuel gas compositions and two oxidizer compositions at two axial combustor locations. Further investigation of the applicability of the model to low calorific value fuel gas fired gas turbine combustors are suggested by the results.

00/01009 Driving today's technology towards tomorrow's leaner, greener car

Eureka Bulletin, 1999, 7, 4–5.

Automobile manufacturers have been feeding environmentally conscious consumers with 'green' marketing messages for a couple of decades now. Yet, despite a surge of R&D activity following the oil crises of the 1970s, the improvement in fuel efficiency that would give substance to their messages has yet to be achieved, and it looks as if car design, as ever is being driven by brand protectiveness rather than genuine 'eco-friendly' principles. However two EUREKA projects, EUROENVIRON-E-AUTO and VEDILIS, are showing the industry how the fuel efficiency of conventional cars can be significantly increased simply by improving existing technologies.

00/01010 The effect of alcohol fumigation on diesel engine performance and emissions

Abu-Qudais, M. *et al.* *Energy Convers. & Manage.*, 2000, 41, (4), 389–399.

The effects of ethanol fumigation (i.e. the addition of ethanol to the intake air manifold) and ethanol-diesel fuel blends on the performance and emissions of a single cylinder diesel engine have been investigated experimentally and compared. An attempt was made to determine the optimum percentage of ethanol that gives lower emissions and better performance at the same time. This was done by using a simple fumigation technique. The results show that both the fumigation and blends methods have the same behaviour in affecting performance and emissions, but the improvement in using the fumigation method was better than when using blends. The optimum percentage for ethanol fumigation is 20%. This percentage produces an increase of 7.5% in brake thermal efficiency, 55% in CO emissions, 36% in HC emissions and reduction of 51% in soot mass concentration. The optimum percentage for ethanol diesel fuel blends is 15%. This produces an increase of 3.6% in brake thermal efficiency, 43.3% in CO emissions, 34% in HC and a reduction of 32% in soot mass concentration.

00/01011 The effect of irreversibilities on solar Stirling engine cycle performance

Costea, M. *et al.* *Energy Convers. & Manage.*, 1999, 40, (15–16), 1723–1731.

The purpose of this study is to determine the effect of pressure losses and actual heat transfer on the performance of a solar Stirling engine. The model presented includes the effects of both internal and external irreversibilities of the cycle. The solar Stirling engine is analysed using a mathematical model based on the first law of thermodynamics for processes with finite speed, with particular attention to the energy balance at the receiver. Pressure losses due to fluid friction internal to the engine and mechanical friction between the moving parts, are estimated through extensive and rigorous use of the available experimental data. The results of this study show that the real cycle efficiency is approximately half the ideal cycle efficiency when the engine is operated at the optimum temperature.

00/01012 Effect of pilot fuel quantity on the performance of a dual fuel engine

Abd Alla, G. H. *et al.* *Energy Convers. & Manage.*, 2000, 41, (6), 559–572.

It is well known that the operation of dual fuel engines at lower loads suffers from lower thermal efficiency and higher unburned percentages of fuel. To rectify this problem tests have been conducted on a special single cylinder compression ignition research engine (Ricardo E6) to investigate the effect of pilot fuel quantity on the performance of an indirect injection diesel engine fuelled with gaseous fuel. Diesel fuel was used as the pilot fuel and methane or propane was used as the main fuel which was inducted into the intake manifold to mix with the intake air. Through experimental investigations, it is shown that, the low efficiency and excess emissions at light loads can be improved significantly by increasing the amount of pilot fuel, while increasing the amount of pilot fuel at high loads led to early knocking.

00/01013 Exergetic optimization of intercooled reheat chemically recuperated gas turbine

Abdallah, H. *et al.* *Energy Convers. & Manage.*, 1999, 40, (15–16), 1679–1686.

The capabilities of the chemical recuperation of exhaust and compressor intercooling heat from gas turbines have been investigated in this paper considering methanol as primary fuel for the Reheat InterCooled (intercooler heat is recovered) Aeroderivative Gas Turbine. The model includes an exergy analysis method and a simplified blade cooling model. The location of the intercooler, the reheat combustion chamber as well as the overall pressure ratio have been optimized. Comparisons are made with the Chemically Recuperated Gas Turbine (CRGT) cycles using methane as a primary fuel.

00/01014 Final results from the state of Ohio ethanol-fueled light-duty fleet deployment project

Chandler, K. *et al.* *Soc. Automot. Eng., [Spec. Publ.] SP*, 1998, SP-1391, (Alternative Fuels 1998), 189–197.

A project was established by the state of Ohio to demonstrate the use of ethanol flexible-fuel vehicles (FFV) in their fleet operations. Ten FFVs and three gasoline vehicles operated by five state agencies were included in the study. During the two-year project a large amount of data was collected, including information on vehicle maintenance and fuelling, cost of operation and fleet management comments. Emissions testing of two ethanol FFVs and two standard gasoline vehicles were also included in the project. The results indicate that the ethanol FFVs are operating well and meeting the requirements of the state agency operators.

00/01015 Fuel system development to improve cold start performance of a flexible fuel vehicle

Stodart, A. *et al.* *Soc. Automot. Eng., [Spec. Publ.] SP*, 1998, SP-1391, (Alternative Fuels 1998), 199–205.

An investigation into a method of starting a spark ignition IC engine in cold ambient conditions, that usually operates on methanol or ethanol is described in this paper. Hardware was designed and installed in two Volvo S70 vehicles, which made it possible for gasoline to be delivered to the